

[54] **IMPACT SENSING TARGET**

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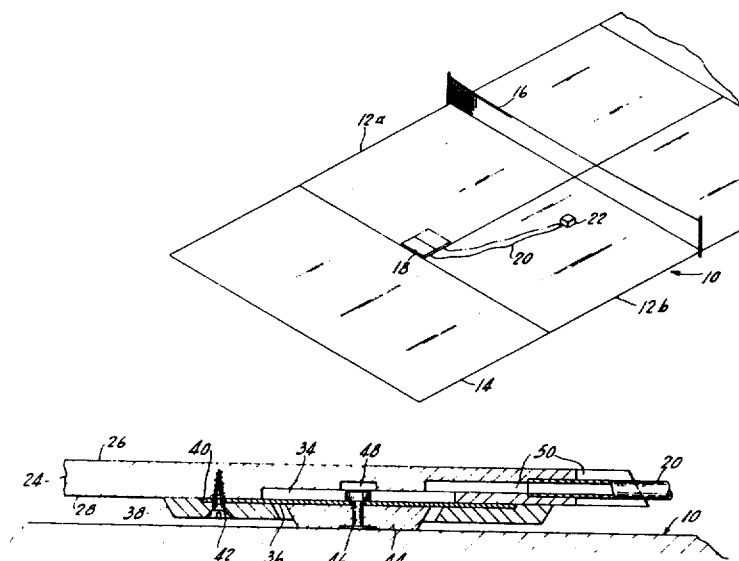
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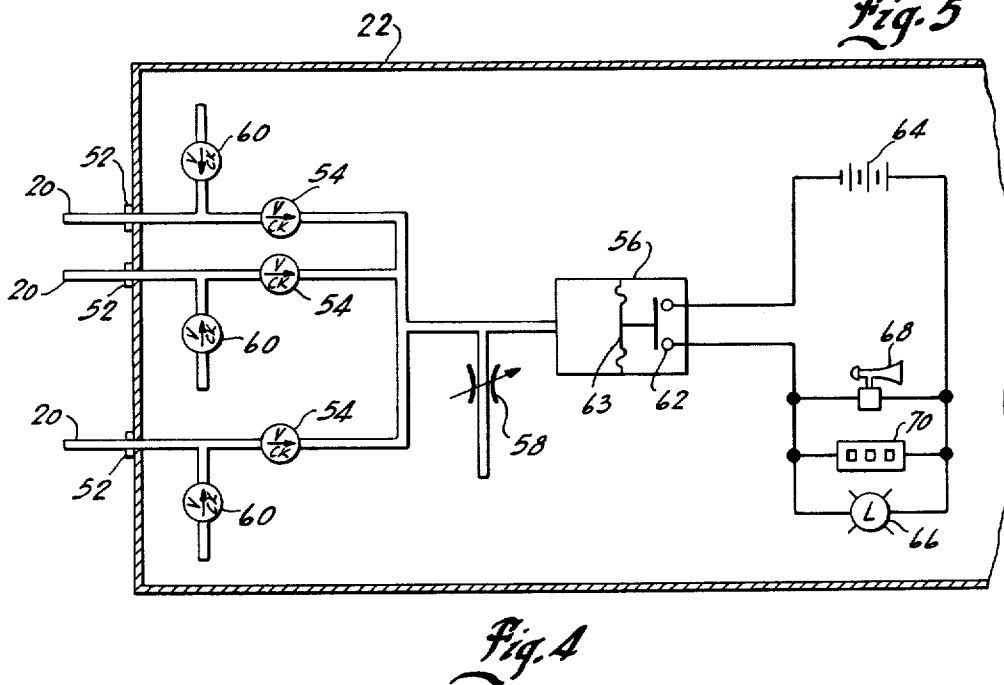
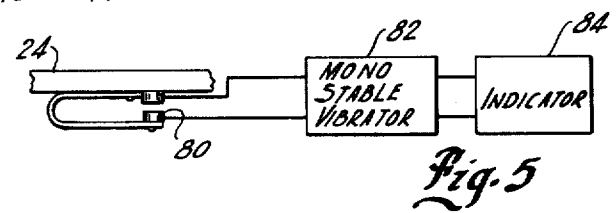
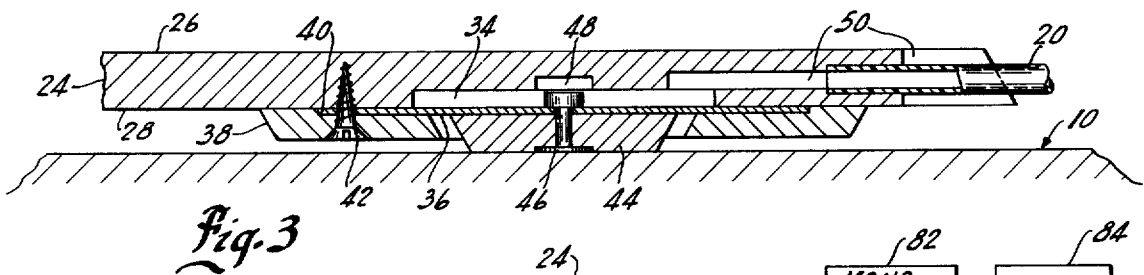
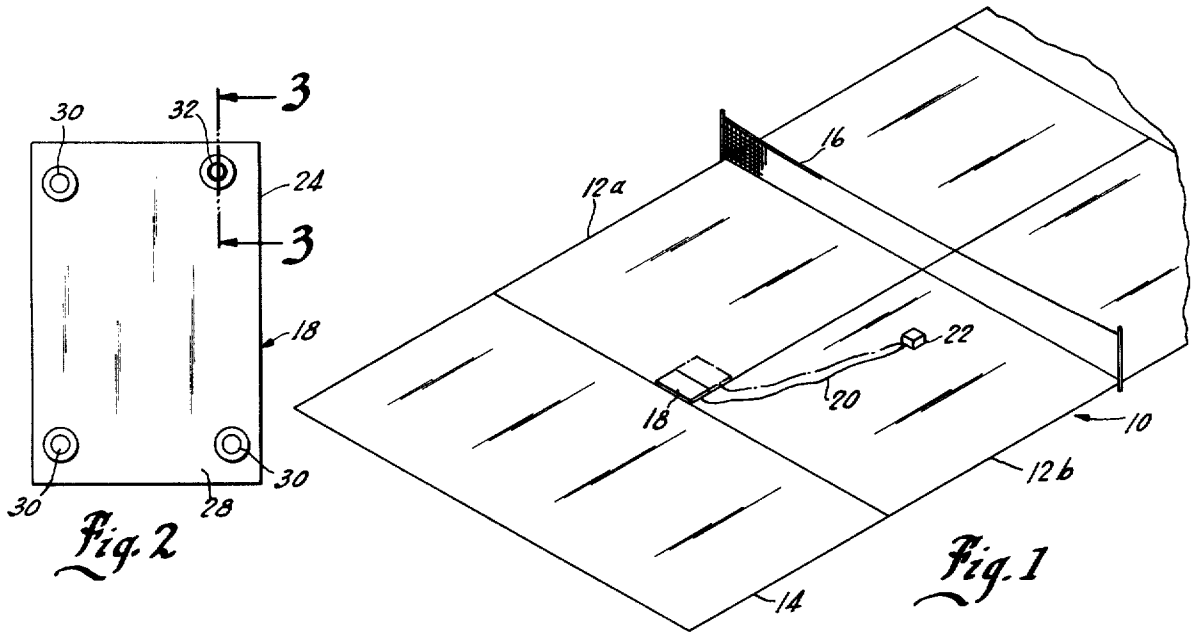
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[57] **ABSTRACT**

A target for being positioned on a surface such that an object impinging thereagainst will deflect the target to generate a pulse which is transmitted to an indicator such as a horn, a light, a counter, etc. The target comprises a flat panel having a cavity therein and placed on a surface. The cavity is bridged by a diaphragm which is deflected when the target is hit by an object. Connected to the target is a transmitter such as an elongated tube. The other end of the transmitter is connected to the indicator. When the diaphragm is deflected by virtue of an object hitting the panel, a pulse is generated through the transmitter to the indicator. The transmitter and cavity are provided with a device which maintains ambient pressure therein.

17 Claims, 5 Drawing Figures





IMPACT SENSING TARGET

FIELD OF THE INVENTION

The present invention relates to a target capable of sensing impacting objects.

BACKGROUND AND SUMMARY OF INVENTION

The present invention relates to a means for accelerating the learning of basic tennis skills, and more specifically, to a device which enables a tennis player to rapidly achieve and maintain a high level of accuracy in hitting tennis balls to selected areas of the court during both service and play.

The invention consists of an impact sensing target having associated therewith a means for providing a prolonged and intensified visual or audible indication of the impact of a tennis ball on the target. It is well established that feedback indication of this nature accelerates learning and execution of desired behavioral patterns such as tennis skills. The target is placed at a desired location on the tennis court and the player practices hitting balls toward the target. A number of targets may be placed at various locations on the court to enable the player to practice certain prescribed tactical hitting sequences. The size of the target area may be increased by employing a plurality of targets at each location.

In a preferred embodiment of the invention, the target includes a panel which is positioned on the tennis court. A cavity on the bottom of the panel is closed by a diaphragm having a foot abutable with the tennis court. The cavity is coupled to a pneumatic - electric transducer which in turn is coupled to an indicating means. When a tennis ball strikes the panel it causes a deflection of the diaphragm creating a pneumatic pulse for operating the transducer and the indicator.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a tennis court showing a typical use of the impact sensing target of the present invention.

FIG. 2 is a view of the underside of one embodiment of the impact sensing target of the present invention.

FIG. 3 is a cross sectional view taken along the line 3-3 of FIG. 2 showing, in detail, the sensing means of the target.

FIG. 4 is a schematic diagram of an indicator means suitable for use with the impact sensing target of FIGS. 2 and 3.

FIG. 5 is a diagrammatic view of another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1, there is shown therein a tennis court 10 of standard dimensions and construction. Tennis court 10 includes a pair of forecourts 12a and 12b and a backcourt 14 on each side of the net 16.

The impact sensing target of the present invention is designed for placement on tennis court 10 to enable a tennis player to practice hitting tennis balls to desired locations.

As an example, it may be assumed that a player desires to practice service to the center corner of forecourt 12a. For this purpose, impact sensing target 18 is located at the center corner of said forecourt. Depending on the level of skill of the player, the target area

may be increased by the use of a plurality of targets 18, as shown in dotted lines in FIG. 1. Impact sensing target 18 is connected by tubing 20 to indicator 22 for indicating when the impact sensing target has been struck.

Impact sensing target 18 includes panel 24 having a brightly colored upper surface 26 on which objects such as tennis balls impact and a lower surface 28 which is contiguous with tennis court 10 when impact sensing target 18 is in use. Panel 24 is formed of material of sufficient stiffness to resist the impact of the objects and to transfer such impact to the sensing means. Plywood, $\frac{3}{8}$ inch in thickness has been found suitable for this purpose. In order for impact sensing target 18 to furnish sufficient practice incentive or challenge, it has been found desirable to dimension panel 24 according to a predetermined ratio relative to the dimensions of tennis court 10. For example, panel 24 may be dimensioned relative to the dimensions of the forecourt or backcourt so that target 18 occupies a preselected fraction of these areas. It has been found that dimensioning panel 24 equal to approximately 1/50th of the forecourt or backcourt provides a target which relates well to intermediate through advanced levels of tennis skill while facilitating transportation and handling of the targets.

Four projections extend from lower surface 28 of panel 24 for supporting impact sensing target 18 on the playing surface of tennis court 10 when the target is in use. Three of these projections may comprise rubber pads 30 or other suitable resilient, non skid elements located adjacent three of the corners of panel 24. The fourth projection, located adjacent the remaining corner of panel 24, is sensing means 32.

Sensing means 32 includes cavity 34 shown in FIG. 3. Cavity 34 may be formed in panel 24 by cutting out a disc of the panel. A diaphragm 36 is positioned across cavity 34 to seal the cavity into a chamber. Diaphragm 36 must be sufficiently stiff to support its share of the weight of panel 24 and to resist damage should target 18 accidentally be stepped on. On the other hand, diaphragm 36 must be sufficiently flexible to deflect upon ball impact to generate a pneumatic pulse, as hereinafter described. Stainless steel approximately 0.006 inch thick has been found suitable for use as diaphragm 36. To position diaphragm 36 across cavity 34, ring 38 having annular groove 40 for receiving diaphragm 36 may be placed over the diaphragm and the ring and diaphragm affixed to panel 24 by screws 42.

In the center of diaphragm 36 is mounted pad 44 which engages the playing surface of tennis court 10. Pad 44 is affixed to diaphragm 36 as by rivet 46. The depth of depression 48 is selected such that should panel 24 be stepped on, the upper surface of rivet will strike the bottom of depression 48 before excessive and possibly damaging deflection of diaphragm 36 takes place. The thickness of pad 44 is greater than the thickness of ring 38 so that pad 44 extends below ring 38 to engage the playing surface of tennis court 10. Cavity 34 contains outlet 50 which is connected to one end of tubing 20. The other end of tubing 20 is connected to input 52 of indicator apparatus 22, as shown in FIG. 1.

Indicator 22 may contain a plurality of inputs 52 suitable for connection to tubing 20. Each of the inputs 52 is connected in parallel through check valves 54 to pneumatic-electric transducer or switch 56 shown diagrammatically in FIG. 4. Pneumatic-electric transducer 56 may be of the type made and sold by the Fairchild

Industrial Products Co. of Commock, New York under the designation PSF 100A. Pneumatic pressure of 0.5 inch of water will operate transducer 56. Variable orifice 58 connected to the input of transducer 56 opens to atmosphere as do check valves 60.

The switch contacts 62 of pneumatic-electric transducer 56, operable by bellow or diaphragm 63, are connected in series with battery 64 and an indicating means. As shown in FIG. 4, such indicating means may include a visual indicator, such as light 66, an audible indicator, such as horn or buzzer 68, and a counter 70 for recording the cumulative number of impacts on the panel or panels 24 connected to indicator 22. Light 66, buzzer 68, and counter 70 are connected in parallel.

In use, the tennis player hits the tennis balls towards impact sensing target 18. When a ball strikes upper surface 26 of the target the impact force exerted on panel 24 causes pad 44 to deflect diaphragm 36 into cavity 34 generating a short pneumatic pulse in the cavity. The pneumatic pulse is transmitted through tube 20 to input 52 of pneumatic-electric transducer 56 via check valve 54 to connect battery 64 to the indicating means, causing operation of one or more of light 66, horn 68 and counter 70.

The air compression pulse produced by the sensing means 32 and transmitted via tubing 20 is trapped by check valve 54 within a volume including bellows 63 and the tubing coupling pneumatic-electric transducer to check valves 54 and variable orifice 58. The resulting pressure, which is considerably less than the compression pulse amplitude, but many time greater than that required to actuate the transducer, is gradually reduced to the ambient pressure condition through variable orifice 58. This gradual reduction of the pressure condition corresponds to the prolonged indication which is vital to the effectiveness of the present invention as a teaching device. Variable orifice 58 is adjusted so that the pulse produced pressure applied to pneumatic-electric transducer 56 is bled off at a rate commensurate with the desired indicating time of the indicator 22. The longer the desired indicating time, the slower the bleed-off of the pressure.

When the pneumatic pressure resulting from the pulse-volume interaction, described above, has been bled off to a sufficiently low level, pneumatic-electric transducer 56 disconnects the indicating means from battery 64 and impact sensing target 18 is ready to receive another impact. Check valves 60 maintain ambient pressure in tubing 20 and sensing means 32.

While indicator 22 is shown as a separate element it will be appreciated that all or part of it may be incorporated into panel 24, if desired. For example, the entire indicating means may be made integral to panel 24. Or, the pneumatic-electric transducer may be incorporated in panel 24 and connected to the indicator 22 by wires. If it is desired to eliminate a tangible connection between panel 24 and indicator 22, the pneumatic-electric transducer may operate a radio transmitter in panel 24 for supplying pulse signals to a suitable receiver coupled to the indicating means.

Further, while a pneumatically operable device has been described above it will be appreciated that other means of sensing the impact of the objects may be employed. For example, an accelerometer or the electrical switch contacts 20 shown in FIG. 5 may be so employed. The prolonged signal generation necessary in

the operation of the impact sensing target may be obtained by means such as a latching relay or monostable vibrator 82 interposed between the sensing means and an electrically operated indicator 84.

We claim:

1. A target positionable on a relatively unyielding surface for sensing the impact of objects comprising:

a stiff panel having means for locating said panel on the surface;

a sensor including a cavity in said panel having a diaphragm means mounted thereacross for sealing said cavity into a chamber and having means on said diaphragm means for engaging said surface; and

tubular transmitting means connected to said chamber and having means for maintaining the transmitting means and chamber at ambient pressure,

said diaphragm means being formed of a material possessing sufficient stiffness to provide a transient deflection from a quiescent position responsive to object impact forces sufficient to generate a transient pneumatic pulse for travel down said transmitting means.

2. The target of claim 1 wherein said surface comprises a tennis court and the area of said panel is a predetermined fraction of the tennis court area.

3. The target of claim 1 wherein said diaphragm means is formed of a material sufficiently stiff to support a proportionate share of the weight of said panel yet sufficiently flexible to transiently deflect on object impact.

4. The target of claim 3 wherein said diaphragm means includes means for limiting the deflection of said diaphragm to avoid damage thereto.

5. The target of claim 4 wherein said deflection limiting means includes means mounted on said diaphragm means and abutable with the interior of said cavity.

6. The target of claim 1 further including a pneumatic pressure operated transducer having a fixed volume and including unidirectional flow control means interposed between said transmitting means and said transducer for isolating said fixed volume and for permitting entry of the pneumatic pulse created by said diaphragm means into said volume to establish a pressure therein sufficient to operate said transducer.

7. The target of claim 6 including indicator means coupled to said transducer for providing a perceptible indication of object impact.

8. The target of claim 7 wherein said indicator means includes a visually perceptible indicator.

9. The target of claim 7 wherein said indicator means includes an audibly perceptible indicator.

10. The target of claim 7 wherein said indicator means includes a counter.

11. The target of claim 7 wherein said target includes said transducer located in said panel and includes further transmitting means coupled to said transducer for transmitting a signal corresponding to said pneumatic pulse to said indicator means.

12. The target of claim 11 wherein said further transmitting means comprises wires.

13. The target of claim 11 wherein said further transmitting means comprises a radio transmitter and receiver.

14. The target of claim 6 wherein said transducer includes bleed means coupled to said volume for reduc-

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ing the pressure in said volume over a predetermined period of time.

15. The target of claim 14 wherein said bleed means is adjustable for adjusting the duration of said period of time.

16. The target of claim 6 wherein said unidirectional

flow control means comprises check valve means.

17. The target of claim 1 wherein said means for maintaining ambient pressure comprises check valve means connecting said transmission means and the surrounding atmosphere.

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